



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

THE METAPHYSICS OF SCIENCE.

SCIENCE is a knowledge of phenomena and of their orders of succession.

Sensible phenomena are qualities or changes existing in relation to our faculty of external cognition. The relation is only that mode of existence, as to time, place, or nature, which awakens in us a consciousness of power exerted upon us, and a reference of the impression to an external phenomenon as its concomitant. Qualities or changes which exist without such relation are not phenomena capable of constituting material of human science.

An order of succession or mode of sequence among phenomena may be cognized as invariable or variable. When a certain mode of sequence is cognized as repeatedly and continuously occurring, we generalize by calling it fixed and invariable. The invariable order of succession of two or more phenomena is the *law* in accordance with which the occurrence of the sequents is regulated. The law being ascertained, we feel confident, whenever the antecedent is cognized, that one or more sequents will come into existence. We thus predict events on the strength of our confidence in the uniformity and irrepealability of the law induced. Whenever a mode of sequence is cognized which is not repeated, or is repeated only in such manner that no regularity or uniformity is discovered, we record it, for the time, as a variable mode of sequence. We fail to induce the *law* under which the phenomena come into existence.

Yet we are psychically so constituted as to believe in the *uniformity of nature*. Even orders of succession which seem capricious or chaotic must imply some law under which they succeed, and in the eye of which they are invariable. In this intuitive faith we seek to discover the law.

The method of the search is the mental juxtaposition of two or

more series of successions judged to be fundamentally cognate, and the selection of such terms in the juxtaposed series as exactly coincide with each other. These terms, thus observed to recur in fixed order, yield the law of their occurrence. The intercalated terms remain apparently adventitious, and must occur in accordance with one or more different laws which may remain undiscovered, or may be discovered, one by one, by means of the juxtaposition of a larger number of series, and the exercise of a broader mental power of holding phenomena before attention, and selecting the like and neglecting the unlike. This is well illustrated by the method of astronomy in selecting from an apparently chaotic mass of observations such as agree in time and position with a given set of observations, and thus afford ground for the elimination of the law of the motion of a newly investigated planet or comet, or the law of correlation between sun-spots on the one hand and auroral displays, magnetic disturbances, or Indian famines, on the other.

It is the work of science to extend, as far as possible, the knowledge of phenomena. It is its higher work to arrange phenomena into homogeneous groups—that is, into series of successions in which the terms appear to possess some fixed relations of time, space, or nature to each other. It is the highest work of science to *perfect* the classification of phenomena and induce the laws under which they occur.

The work of science has proceeded so far that innumerable phenomena, which were once regarded as isolated, are known to occupy fixed places in invariable sequences which come into existence under laws of nature.

Isolated phenomena were regarded in unscientific ages as occurring by chance, or through the momentary volition of beings possessing control of particular departments of nature, or of the whole of nature. A sentiment universal, and undoubtedly innate in humanity, prompts intelligence to recognize the existence of one or more superior beings, to whom the direct or indirect causation of phenomena may be ascribed, and toward whom a feeling of veneration may be directed. As fast as science has succeeded in relegating under law any of these supposed isolated phenomena, they have been viewed as accounted for and explained, without recourse to the volition of superior beings. To such extent, these beings have seemed to be retired from participation in the affairs of the world, and the religious feeling has been robbed of occasions for its exercise. Hence the progress of science has seemed to antagonize the

religious sentiment. Science has, therefore, been denounced as atheistic, while, on the other hand, the religions of men have been despised as ignorant and superstitious.

The work of science, as just stated, consists of observation, comparison, and induction. Obviously, a law reached by induction from facts is a principle from which other facts may be deduced ; and this is one of the legitimate and characteristic processes of science. Science, in the full exercise of all its functions, is not, therefore, exclusively inductive.

Without observation, the material of science would not exist. There could be neither comparison, induction, nor deduction. Without comparison, no affiliated juxtapositions of phenomena would exist ; and we should reach neither the laws which regulate them, nor an anticipation of other phenomena coördinated under the same laws. Without induction, the observation of phenomena would only create a mass of undigested material, like that which accumulated in the observatory of Tycho Brahe. Without deduction, the universe of phenomena would present the order and symmetry of a perfect machine, the products of whose activity we could know only as they were wrought out. Anticipation—prediction—and all the plans and operations based upon expectation, would have no place among human activities if science could not descend from principle to fact. All conceptions of phenomena that have not been objects of cognition must be based on deduction, proceeding from general principles established by induction from cognized phenomena. By such means science has affirmed the internal solidity of the earth, or predicted the eccentricity of her orbit at an epoch a million years in the future, or pictured her physical condition in a past removed from us by millions of years.

Such seem to be the scope and prerogatives of that department of science whose data are sensible phenomena. The term science, in its modern, popular acception, signifies the science of sensible phenomena. When the term is employed without qualification, it is generally understood to signify *physical* science.

There are, however, other fields of phenomena—using the term in an extended but legitimate sense—cognizable through internal instead of external perception. The phenomena of the mind have an existence as certain, and orders of succession as fixed and cognizable as the phenomena of the external world. The reality of mental phenomena is absolutely unquestionable. They are, in fact, the only data of demonstrable knowledge. Sensible phenomena are

only names which we ascribe to assumed external manifestations *believed* to be coördinated with cognized internal phenomena. Hence the certainty of external phenomena is conditioned on the validity of this belief. External phenomena, therefore, can not become so immediately, even if they can so certainly, the materials of valid knowledge, as those phenomena which arise in the mental field.

Among the phenomena of consciousness we have to make, therefore, the following discriminations: 1. Mental states, or psychic modes, without regard to their sources, occasions, or coördinations to any other facts than mental states. 2. Those among the mental states which we irresistibly refer to external phenomena as their correlates and causes. But there is also a third category of mental states, or inner perceptions, which we irresistibly refer to abstract and necessary truths. This reference of these states to necessary truths as their correlates and causes is the intuitive perception of necessary truths.

The truths thus cognized as having a necessary, universal, and eternal existence are truths concerning necessary being and necessary relations. Space and time are existences which must be held necessary in the same sense as other truths are necessary; and the relations of portions of them are relations of quantity, which are formulated in well-known axioms and theorems, embraced among the necessary truths which stand as correlates to the third class of mental states. Other truths are the inseparableness of quality and substance, attribute and being, effect and cause, order and intelligence, continuity of existence, universality of law, ultimate unity, and ultimate primordality of existence. Some of these principles have generally been omitted from enumerations of necessary truths; and the reader, if he think proper, can omit them here, as the main purpose is simply to adduce illustrations and not to establish a catalogue.

Finally, we discern a *fourth* class of mental states. These are the assumptions which we irresistibly make of an absolute causal correlation between certain conscious states and realities external to consciousness. We find in existence an assumption that certain states are caused by sensible phenomena; and an assumption that other mental states are caused by the disclosure of certain abstract truths; and an assumption that these abstract truths have a necessary existence in the universe of which we are a part. We find here, also, the assumption of personal existence and personal identity. This fourth group of conscious states impresses a belief in the

reality of sensible phenomena ; in the reality of existence behind these phenomena ; in the reality of supersensible existence underneath all psychic phenomena, and in the reality of truth apprehended as universal and necessary. These subtle, instantaneous, and irresistible *assumptions* are the only bond of connection between us and any realm outside of our own minds. Invalidate them, and all which seems to exist, either in a world without or a world within, resolves itself into a phantasmagoria of forms without substance—a succession of mental states which seems to have a cause and correlative, but has none ; a succession which seems to be concatenated and orderly, but is absolutely chaotic and fortuitous ; a succession of states which, after all, are not states, but only the alluring and deceptive images of states—and not even images, for the seeming must be as fanciful and illusory as the seeming of substance. Deny the validity of the assumption of causal correlations between mental states and realities, and all knowledge is annulled. We float only in a glittering realm of empty forms—we can not say we float, but we seem to float—we can not say we seem to float, but we seem to seem to float. All predication is annihilated. We are conscious, at first, of existing in a world of realities ; then we float in a realm of unsubstantial visions ; then everything—visions and realities alike—sinks into absolute nihility. Such denial is the end of all philosophy and all science alike. What do we say ? All science and all philosophy depend for their validity on the validity of our reference of certain mental states to causal correlates external to the mind.

That the reference is valid, no one can possibly doubt in a practical manner. Denial, even of the speculative kind, is impossible. The utmost which speculative thinking has ever been able to do is, to affirm the *possibility* that such reference is invalid. The history of philosophy has shown that the most eminent propounders of this possibility have found, in after-life, satisfactory ground for holding that the reference is valid ; and that, therefore, a realm of reality exists, and that it is such as reported in consciousness.

Every argument between two parties must proceed on the fundamental admission that those states of mind which have been here described as announcements of a correlation between other states and external realities are truthful announcements. If either party deny this, he deprives himself of all ultimate ground for either affirmation or denial ; and his attempt to reason is like the effort to move the world without the basis for a fulcrum.

After this *conspectus* of the situation, let us examine more at-

tentively the foundations underneath the fabric of physical science.

The current conception of physical science presents it as a body of knowledge. It is commonly regarded as the most certain of all knowledge, and the safest foundation for belief, expectation, and action. Men stand firm on the conclusions of science, however they falter on the isolated propositions which science subsumes. They formulate their creeds on the dicta of science, though they may profess to doubt or to be ignorant in the presence of the naked principles which authenticate the dicta of science.

That science attains to valid knowledge can not be rationally denied. Instead of denying, it is our purpose to demonstrate that it is valid; and that it is valid because certain underlying principles which science never mentions are the firm foundations on which it rests.

I. All science begins in the assumed existence of a real, thinking being. But what is the ground of the assumption of our personal existence and personal identity from moment to moment and from day to day? The conviction is grounded in our inmost consciousness; we are unable to resist it; but it is only a *belief*—a valid belief—the ultimate elemental utterance of mind, speaking with the authority of its very being. Nothing, of course, can validate its utterance; but, if we choose to admit a speculative doubt, we negative at once all possibility of science and all possibility of a scientific basis for anything.

All trustworthiness of memory rests in the presupposition, not only that the representative faculty is a true witness, but that we are the same being as yesterday. The scientist records his notes after hours, days, or weeks have passed; and he builds most serious reasoning on the assumption that it was he who made the observations which he seems to reproduce. If he is mistaken in this, his reasoning is illusory; but he builds, sometimes unmindful of the fact that his fabric rests upon a purely and deeply metaphysical subsumption.

II. Admitting the evidence of personal existence sufficient, other queries immediately arise which must be disposed of. Science we have defined as beginning objectively in a knowledge of phenomena. Now, how do we know that phenomena exist? or, that they exist as they seem? or, that any reality lies behind them? or, that the reality is such as it seems to be? Plainly, all these things are assumed on the naked testimony of the mind. Consciousness reports

external phenomena, and we believe. Consciousness represents them thus and so, and we believe. And then we find disclosed in consciousness a confidence that all phenomena are grounded in real existence, and that such phenomena as these are grounded in a mode of existence sustaining an exact correlation to these particular phenomena. This confidence is only belief in the ultimate verdict of our being. *All science, to be substantial, must assume the validity of all these ultimate beliefs.* The most logical conclusions of science must necessarily imply that there are some propositions which do not admit of logical proof, but which must be received with absolute unreserve. These ultimate propositions are simply believed without reasoning ; but our belief is so strong that we feel it to be knowledge. If it is not knowledge, the fabric of propositions which we build upon it is not knowledge. If it is knowledge, then the plain, simple, ultimate utterances of our minds are the indestructible molecules of all our systems of science ; and the testimony of consciousness respecting the coördination between any of its states and external realities is a direct intuition of truth.

This conclusion can not be evaded. The reality and genuineness of our knowledge of the phenomena assumed as the material of science is absolutely conditioned on the veracity of consciousness in certain of its testimony. Impugn this veracity in any respect, and the genuineness of the materials of science is correspondingly impaired. The more valiantly we affirm the indestructibility of scientific knowledge, the more explicitly we admit the unimpeachable veracity of the direct testimony of consciousness. If consciousness is not admitted as a veracious witness thus far, it is impossible to hold an argument with the reader. If consciousness is admitted veracious, so far as to validate the phenomena from which science proceeds, we may next inquire what are the further implications of scientific knowledge.

III. Supposing the facts of observation to stand in every respect unchallenged, some principles of relation must be tacitly assumed to serve as the ground and authentication of any classification. Whether we associate them with reference to time or place, concomitance or succession, quantity or quality, it is in every case a basis of resemblance. Without some kind of mutual resemblance, no homogeneity or community would be present to justify any general predication. But, when we adopt any kind of resemblance as the basis of classification, we tacitly assume that likeness among phenomena proceeds from community or identity of *cause* ; in other

words, that "like effects proceed from like causes." This is a principle which must be validated by pure reason to acquire that character of certainty, universality, and necessity which we assume it to possess in the use which we make of it. If it be thought a principle resting on a general induction from observation, then admitting (contrary to the fact) that the same absolute certainty could be reached, the very process of generalization assumes still the same principle, that homogeneity of phenomena implies similarity of cause. Hence, when we look to general induction for the validity of the principle that like results proceed from like causes, we find that the induction itself assumes beforehand the validity of the principle; and our effort is simply a case of reasoning in a circle. As general induction can not, therefore, validate the principle which validates general induction, it follows that the principle is validated either by deduction or by the direct sanction of pure reason. But it is not a deductive conclusion, for the principle itself, possessing the highest possible degree of generality, is not the result of an analysis. We discover no account of the validation of the principle except in the sanction of the same rational authority as speaks to us in affirming a correlation between certain conscious states and external realities. Here, then, in the first step which science takes in formulating a general concept or scientific doctrine, it is absolutely necessary to rely on the universal validity of a principle which can not be established by scientific processes, nor indeed by any formal logic whatever.

So, it may be added, the whole search after general laws, or the unification of human knowledge, is prompted and guaranteed by the intuitive conviction that *unity* exists among the diversified phenomena of nature. If no ulterior unity existed, or if reason were not furnished with the knowledge of its existence, the search for general laws and deeper causes would never be undertaken, or if undertaken would be fruitless.

It is extremely easy for the scientific investigator to overlook a metaphysical principle involved in the comparison and classification of concrete phenomena; but, since the principle clearly reveals itself to critical attention, we must frankly acknowledge that the entire fabric of physical science rests upon a truth grounded in the realm of metaphysics; and that this is not for such reason a truth "merely speculative" in the reproachful sense, but a truth which is self-evident, and surer than any scientific conclusion. To a certain class of minds such a statement may not address itself with all the

cogency of a concrete proposition ; but it may impress the necessity of caution in vaunting scientific conclusion from sensible phenomena as the most certain kind of knowledge, and incomparably more substantial than the ethereal abstractions of metaphysics.

IV. When, in the progress of our scientific investigations, we reach the stage of inductive inference, the process of concluding from a part to the whole is based on an assumption of the uniformity of nature, which is only the concrete form of the principle that like results proceed from like causes. If unobserved phenomena belonging to the same group with those on which the inference is based are not ascribable to the same cause, or same kind of cause, we have no right to extend the inference from observed data to these. But the principle of the uniformity of causation is accepted as 'more valid than any inference which we may induce from any array of phenomena, however extended. The inference may express a bond of connection running through the phenomena observed, and no others ; it is therefore not a causal bond. It may express a causal bond, but not the deepest and strongest bond. In any such case the inference is liable to fail in its application to new phenomena. The inference, therefore, can never be unreservedly accepted except when the facts sustain quantitative and therefore mathematical relations to each other. But, however qualified the inference, the metaphysical principle on which it proceeds is never accepted with reserve. Uniformity of causation is felt to be absolute. The common process of inductive conclusion, which is the staple method of science in the evolution of doctrine, requires, consequently, an underlying metaphysical principle to give it any semblance of validity.

V. Granting full validity to the successive steps taken by science in attaining its ultimate generalizations, these are expressions of laws under which successions of phenomena come into existence. The order and method of the cosmos are so far revealed. Its phenomena become intelligible in their mutual relations. The flow of events is systematic, certain, predicable. Nothing happens capriciously, or with any regard to interjected emergencies. No variation in the established order of events can be expected under any supposable circumstances. This is the "reign of law." No ground exists for denying that this reign embraces all the events which make up the history of the irrational world. Nor can it be denied that all rational activities proceed according to some law ; for otherwise there would be no evidence that they are rational. But the laws of

rational activity inhere in rational spontaneity ; those of physical events are imposed by external authority.

But the reign of law means nothing more than the universal prevalence of methodical successions of events. Law is the formula under which events are coördinated ; but law does not produce events. A phenomenon is scientifically explained when we refer it to the law under which it takes place ; but it is not exhaustively explained. For the purposes of science it is adequate to ascribe events to law, because law is the ultimate stadium of scientific ratiocination. It lies on the remotest frontier of scientific territory. Physical law is itself an abstraction, and constitutes the connecting link between the physical and the metaphysical. But, when we say, in the language of science, that events "come by law," we must take care not to conclude that law is their cause. Law explains their order of succession, but does not explain how the law came into existence, nor how events are generated, nor how they are coördinated so methodically. Law is simply the rule of coördination ; efficiency produces them and coördinates them.

Law viewed scientifically is merely a rule of succession ; viewed philosophically, it is an expression of power and intelligence—a synthesis of force and mind. In the purview of science law is the key to unlock the methods of nature—a clew to guide through the labyrinth of phenomena ; in the eye of philosophy it is a preconceived plan of action, purposeful of results. While science rests on law as a finality, philosophy seeks the power which ordains law ; and, viewing law as the expression of will, it insists on the reality of will by all the evidence which science summons to establish the reality of law. Science claims law as an intelligible principle of coördination among phenomena ; and philosophy claims an intelligible principle of coördination as the exclusive product of intelligence. The cosmos is comprehensible by thought because it is the product of thought. Grant the mechanical nature of the processes of the world, the existence of a mechanism which does not express mind is something unthinkable.

Science is under no obligation to assume a strange garb, and make affirmation of the predicates of philosophy. Such freedom may authorize science to ignore the predicates of philosophy, but it confers no privilege to deny them. As long as, maintaining its own character, it ignores the principles, postulates, or axioms of philosophy, it can not antagonize philosophy ; but, when it offers an argument *ex ignorantia*, against the verdict of philosophy, all right

thinking recognizes it as sophistical. It is impossible to grasp the meaning of law with the whole breadth of the intelligence, without apprehending it both as a rule and as an expression of ordaining will.

VI. As law, in its existence, proclaims necessarily a purposive ordination, so the correlation of events under law must necessarily be regarded as a result purposed in law. If law exists as the result of purpose, there must be a reason why it has been purposed; and the reason why can exist nowhere but in the results impressed by the law—that is, in the results which take place according to the law. The coördination of results, therefore, is as much the expression of purpose as the law which embodies the principle of coördination. The fact that events take place according to law, instead of proving their disconnection with purpose, is the very circumstance which demonstrates their dependence on purpose. Caprice and confusion are not the marks of intelligence; high controlling intelligence always seeks its ends by fixed methods of action. The more clearly we discern the reign of universal law, the more clearly we discern the evidence of general design in the phenomena of the universe. The question whether events take place through law or through design is destitute of rational meaning; because, *first*, events are produced neither by law nor by design; and, *secondly*, if they are produced by design, it is, as we see, according to law; and, if they are produced by law, it is according to design in the law. Law and design are so far from being mutually exclusive, that, in truth, they are mutually inclusive. There is no law without design; and, in nature, the design of the law is worked out under the law.

VII. Passing from general design to special design, or the design supposed to be revealed in particular events, or particular correlations of material parts, the foremost question arising concerns the meaning of the metaphysical principle of design. Now, when parts are coadjusted, as in any mechanical combination, like a watch or a human hand, the instinctive verdict of mankind is an affirmation of intention. This affirmation is prompted by the adjustment of *part to part*, and by the adjustment of the whole to its *result*. These two conceptions must be kept distinct. Let us for the moment leave out of consideration the question of design in the result, and note what is implied and what is not implied in the affirmation of design in the parts. We say instinctively that the coadjustment of parts implies design; but—1. It does not imply that the action of the parts was designed to produce any result. 2. It does not imply

that the result, if any, is useful, beautiful, or any otherwise characterized. 3. It does not imply that the result, if any, is either comprehended or comprehensible. 4. It does not imply that the adjustment itself is something wholly comprehensible. 5. It does not imply that the cause of the adjustment is either finite or not finite. 6. It does not imply that the conformations and collocations in the adjustment have been effected by any particular instruments, or according to any particular method. They may have been molded, hewed, carved, turned, or grown—it is all the same. These eliminations are of the utmost importance; but a careful appeal to consciousness demonstrates that our verdict is rendered without the least regard to any consideration save the fact of *coadjustment*—mechanical coadjustment, in which the action of one part is continually reciprocated by the action of another part. Isolating the question of design from these customary entanglements, it is apparent that, when a case of mechanical coadjustment is presented, it is not pertinent to consider whether it is a product of man or of nature. It either implies design absolutely, or it does not imply design at all. The same combination can not imply design when viewed as a human product, and have no significance when viewed as a natural product. The consideration that it has come into existence by a method of evolution, or by any other method, is as alien from the question as if the method had been by an envelope-making machine, or by carpentry, or smithery. It does not add to the conclusiveness of the statement to suggest that a method of evolution may and must have been established by design, and that consequently the ends which it attained may and must have been designed, both in general and in particular. The suggestion, however, is valid, and is perfectly in parallelism with the inference of design directly from adjustment. If the recognition of design, therefore, is legitimate, without any regard to the teleological significance of the products of adjustment, the most radical profession of nescience of the “designs of Nature” may admit that some design is revealed in the simple fact of structural adjustment, even if it were not designed to produce what it produces.

This is not that remote and hypothetical admission of design which recognizes simply the possibility that the whole system of nature may exist for some design; but it is an affirmative and necessary recognition of design, as the logical antecedent of all coördinations interpretable in terms of intelligence.

VIII. Besides mutual adjustment of structural parts, we may

consider the meaning of adjustments to a general concept. All that we know of fundamental plans of structure in the organic world is but a body of facts exemplifying adjustment of parts, not alone to each other, but to an archetypal conception—an intelligential standard. It is frequently suggested that fundamental relationships have resulted from the law of heredity, with progressive divergence. That, probably, is a valid scientific account to give of what have been styled *plans* of organization; and every one is free to rest in the finality of science. But, if our minds are so constituted that we irresistibly conclude design from coördination, regardless of the instrumentality or means by which the coördination becomes expressed in matter, then heredity with divergence is not an ultimate explanation, and every man is at liberty, without reproach, to pass beyond the pale of science, and recognize heredity as a thoughtful determination fixed for the purpose of introducing order and method into the organic world, as we find them. So the mathematical order of the solar system is explicable in scientific terms, by ascribing it to the cooling of a primitive nebula; but the forces engaged in the evolution of a planetary system must be rationally conceived as merely the instruments which work out symmetrical results coördinated to a general concept or plan. If, finally, the deepest law of nature is the law of evolution, we may recognize that as the all-embracing principle under which events emerge into being; but reason can never be divested of the simple conviction that events coördinated on so comprehensive a scale, and coördinated to so vast a scheme, give expression to purpose equally vast and comprehensive. The explanations of science are held to be valid, but they do not go far enough; they are not ultimate explanations. By the inherent principles of our mental being, we postulate and posit motive and agency behind the last explanation of science.

IX. As design is the necessary implication of parts coördinated to each other, or to a general concept, so metaphysical cause is the only rational explanation of those ultimate physical antecedents which belong to the category of sub-causes or scientific causes. Of metaphysical cause science professes to have no knowledge, holding that invariable antecedence is the scientific conception of causation. But, manifestly, no phenomenon comes into existence *because* another phenomenon precedes. The precedence is the sign of antecedent efficiency. So the law under which a phenomenon arises is modal, not causal, and implies prior ordination, as the subordinated event implies transcendent causation. The *conditio sine qua non* of

a phenomenon is not its essential cause, but the condition of the operativeness of a certain law which expresses a method of activity of essential cause. The notion of metaphysical cause is therefore the underlying ground of all the ultimate conceptions of science.

That notion, in spite of the formal restriction of the logic of science, has found constant expression in scientific language under the name of *force*. This, like the assumed atom and molecule of physics, the ethereal medium and the ultimate incompressibility of matter, is a purely metaphysical conception. It is a name which the necessities of thinking have impelled us to adopt for the efficiency transmitted from or through the phenomenon which stands in the place of invariable antecedent. Yet there are questions still deeper which offer themselves as subjects of analytic thought. Is force an entity or an attribute? If an entity, is it self-acting or subordinated? If subordinated, what is the nature of the power which subordinates it? If self-acting, then the discernment and design revealed in the results of its activity are attributes which characterize a demiurge. But, if we say force is an entity which produces results, what is the means by which it produces them? Are not all results produced by force, and is not our reasoning thus reduced to the proposition that the entity force employs force to produce results? This proposition is unintelligible, and shows that the conception of force as an entity is absurd. Force is an attribute.

But, if force must be conceived as an attribute, what is the nature of its subject? *What* is it which exerts or manifests force? To say that the attribute force exerts itself is to make it both attribute and subject. Something which is not force, but which is capable of exerting force, is therefore necessarily implied in the conception of force. Is matter the subject? Then, *first*, it is a subject which thinks and purposes; for the results of force are thoughtful and purposive, and matter does thus possess a "power and potency" of psychic results. But, *secondly*, we are not certain that matter possesses a subjective nature. We only know matter phenomenally, and it may easily be that phenomena constitute all there is of matter in itself. Yet phenomena are manifestations of something possessing the power to produce them. The phenomena which we cognize as matter are manifestations of force. If there be no subject matter, there must be some other subject revealing itself in the phenomena which we group under the designation of matter. We are driven, then, to the recognition of an intelligent subject as the ground of the attribute of force manifesting its activ-

ities in the being of what we call matter, as well as in the changes which are impressed upon matter.

The inquiry does not end even here ; for it remains to ascertain what is the mode of origin of force from its subject. What is the method by which the subject reveals the attribute of force? Is forceful emanation from the subject an unconscious and continuous necessity of its being ; or is it a conscious and voluntary activity? If necessary, then some higher power has imposed the necessity ; if unconscious, then some higher intelligence directs according to the laws of conscious thought ; for coördination of products implies at least two things consciously apprehended both in their separateness and in their relation ; unconscious intelligence is a nugatory expression, for consciousness is the prime moment of intelligence. If forceful manifestations are effected through the method of volition, then the subject which constitutes the ground of all cosmical force is possessed of will as well as intellect and susceptibility to motive, and is consequently a personal entity—an entity thinking, feeling, and willing with reference to that which is not itself.

Finally, all the distinctive doctrinal enunciations of modern science are conclusions which reach beyond the peculiar domain of science. One class of these is constituted of applications of the metaphysical principle of continuity, through which is deduced the evolution of the forms of inorganic matter from a primitive homogeneous state, and also the forms of organic matter from a primitive vitalized plasma. Another class is a body of enunciations respecting the causation of origins. The method and order of origins are the subject of legitimate scientific research, but essential causes, as we have stated, lie quite within the region of the metaphenomenal.

It appears, therefore, as Lewes states, that “the fundamental ideas of modern science are as transcendental as any of the axioms of ancient philosophy,” and that “every physical problem involves metempirical elements.” All the fundamental conceptions of science—self, substance, cause, force, life, order, law, purpose, relation, unity, identity, continuity, evolution, natural selection, species, genus, order, class—are purely metaphysical concepts or ideas. These are not the objects of sensible perception, like the phenomenal data of science, but are apprehended by the rational insight. Many of them are the logical antecedents and necessary conditions of the possibility of experience. They precede and legitimate all our cognitions and judgments concerning the sensible world, and act as the

constitutive and coördinating principles among our sensations. They render possible the logical contemplation and intelligent penetration of nature. They constitute the bond of consistence and coherence in the fabric of science, and illumine the system of the cosmos with the supernal light of thought.

The foregoing suggestions are intended to reveal clearly to the intelligent reader the existence of a realm of legitimate thought deeper than the data of physical science ; presupposed, indeed, by all the logic of science, and sole sponsor for all the validity which the principles of science can ever acquire. The effect is not to impair the authority of science, but to rationalize it and purge it of empiricism and dogmatism. The moral is, that science, from its platform, is not competent to utter conclusions on themes which lie over in the realm of metaphysics ; but, when it gives utterances, either affirmative or negative, on questions essentially metaphenomenal, it must proceed from the axioms of metaphysics, and not from the inductions based on sensible phenomena.

ALEXANDER WINCHELL.